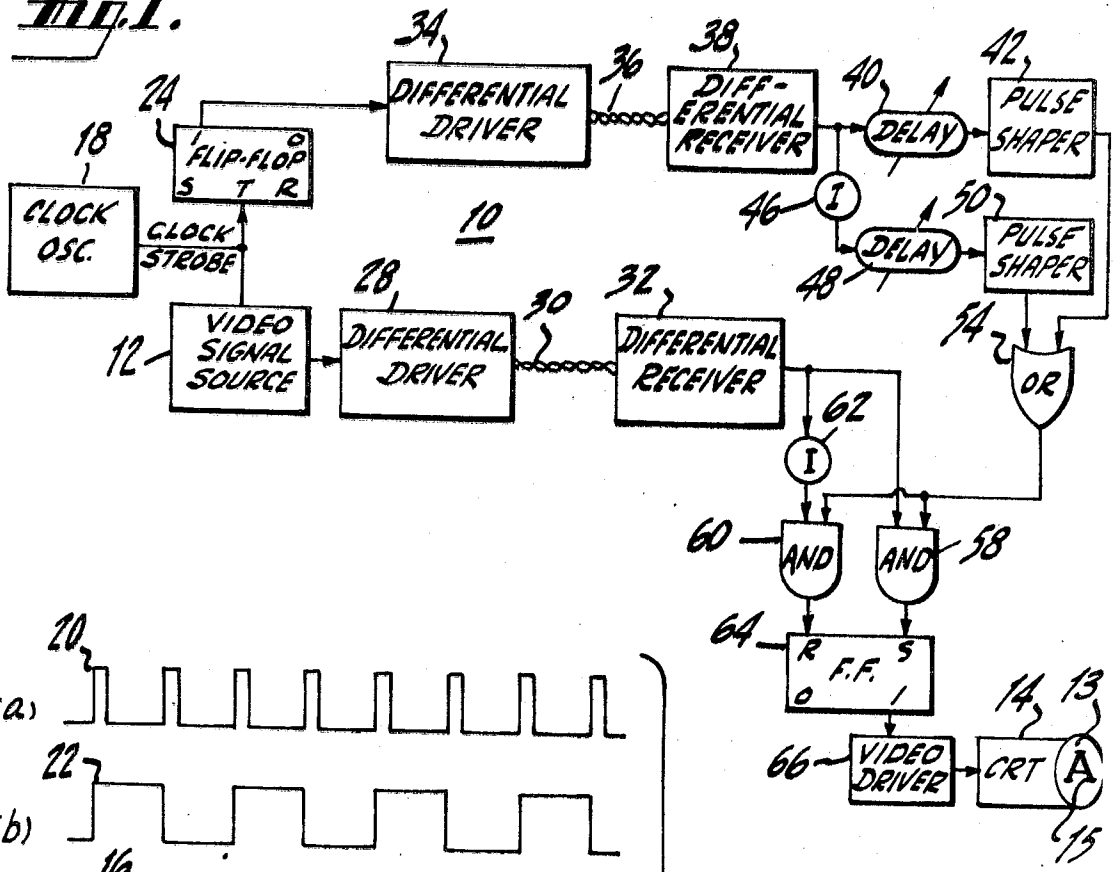
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BILEVEL VIDEO SIGNAL RECONSTRUCTION CIRCUIT

Filed July 1, 1968

Fig. 1.



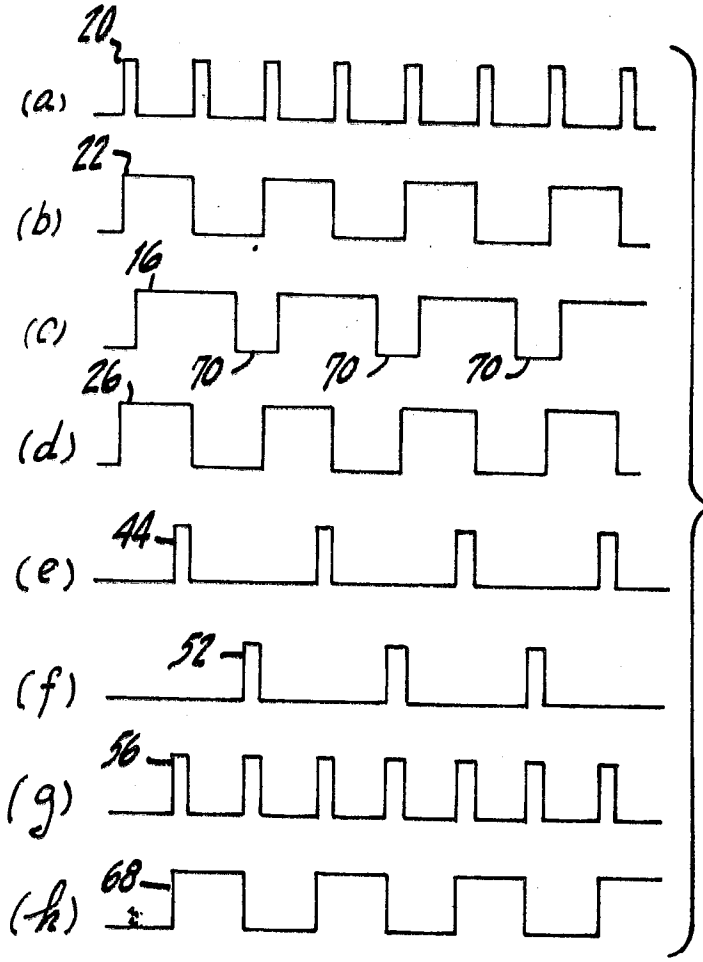




Fig. 2

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# BILEVEL VIDEO SIGNAL RECONSTRUCTION CIRCUIT

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U.S. Cl. 328—164 5 Claims

## ABSTRACT OF THE DISCLOSURE

A bilevel reconstruction circuit eliminates pulse width distortion in bilevel video signals so as to provide an accurate replica of the original video signal prior to the introduction of such distortion.

## BACKGROUND OF THE INVENTION

Mechanical and photographic techniques of composing types are relatively slow and the probability of increasing the speed of such type composition systems by a significant amount appears to be small. The successful transformation of type composition into an electronic art promises to increase greatly the speed of type composition. Recently, electronic photocomposition systems have become commercially available. One such system utilizes an imaging device such as a cathode ray tube to create characters by a plurality of adjacent scan lines that form slices of the characters. The cathode ray tube beam is turned on and off by a bilevel video signal while the beam scans in a linear sweep. A memory is incorporated into such electronic photocomposition systems to store instructions as to when the cathode ray tube beam should be blanked and unblanked to provide the character slices at the right times. The characters so formed on the cathode ray tube are imaged onto photographic film for later processing into printing plates. Such electronic photocomposition systems are being called upon to process an ever increasing amount of graphic material at high operating speeds and to do so while maintaining an impeccable quality in the construction of the graphic characters.

The circuits that process the bilevel video signals that effectively form the characters on the imaging device are operated at the upper limits of their operating speeds. Such operation frequently results in considerable pulse width distortion of the bilevel video signals which in turn results in poor graphic characters being formed in the imaging device. The problem is further complicated by the fact that at times the bilevel video signals have to be transmitted over comparatively long distances to the imaging device. Such transmissions may also introduce distortion.

## SUMMARY OF THE INVENTION

A bilevel video reconstruction circuit for a character imaging system removes pulse width distortion from a distorted bilevel video signal by generating a squarewave retiming signal that is a replica of the maximum frequency video signal that can be processed by the system. The positive and negative going transitions in the squarewave retiming signal are utilized to generate first and second groups of timing pulses respectively. The first and second groups of timing pulses are gated with the distorted bilevel video signal and an inverted version of the distorted bilevel video signal to provide a reconstituted bilevel video signal that exhibits the correct pulse widths.



## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic block diagram of a bilevel video reconstruction circuit embodying the invention, and

FIG. 2 is a series of graphs illustrating the signals that occur in various parts of the circuit of FIG. 1.

## DETAILED DESCRIPTION

Referring now to FIG. 1, a bilevel video reconstruction circuit **10** includes a source **12** of bilevel video signals which are to be displayed on the face **13** of an imaging device such as a cathode ray tube (CRT) **14**. In an electronic photocomposition system, the source **12** may, for example, comprise the memory and associated processing circuits from which the bilevel video signals are derived. The video signals are bilevel since graphic characters **15** are formed by the bilevel blanking and unblanking signals applied to turn off and on the electron beam in the imaging device **14**. The actual video signals from the source **12** may, for example, be such as that shown by the waveform **16** in line C of FIG. 2. The video signals are read from the source **12** at a clock strobe rate as determined by a strobe pulse signal derived from a clock oscillator **18**. A strobe pulse signal **20** is shown in line *a* of FIG. 2. The video signal **16** in FIG. 2 is represented as a distorted signal with the video signal **22** in line *b* of FIG. 2 comprising the ideal undistorted video signal counterpart of the signal **16**.

It is to be noted that the ideal video signal **22** is essentially a squarewave signal with the two levels in the signal exhibiting the same half periods. However, the distorted signal **16** exhibits a slight delay in the leading edge thereof and a longer delay in the trailing edge. If the leading and trailing edges were delayed the same amount, then, of course, there would be no distortion in the characters **15** formed on the face **13** of the cathode ray tube **14**. The pulse width distorted video signal **16** may, for example, be caused by failure of transistors to turn off at the correct time due to charge storage effects. The distortion may also be due to capacity storage effects in lead lines, and the like.

Since the ideal video signal **22** in FIG. 2 changes levels at the strobe pulse **20** rate, the video signal **22** is the maximum frequency signal that can be processed by the photocomposition system in which the reconstruction circuit **10** is embodied. The design of the reconstruction circuit **10** is based on the premise that if the video signals that occur at the maximum frequency rate can be accurately reconstructed, then the video signals that occur at lesser frequency rates can also be reconstructed. It is to be noted that even though the bilevel signals exhibit either pulse narrowing, or pulse widening distortion, they still exhibit the same frequency rate, i.e., pulse repetition rate, as the undistorted signal counterpart thereof. Thus, the transitions in levels for each period of the distorted bilevel signal **16** still exhibit the proper timing. For the maximum frequency signal these transitions are, of course, one half the pulse repetition rate of the strobe pulse signal **20**. Accordingly, a retiming signal which is a replica of the maximum frequency signal is generated from the strobe pulse signal **20** by applying the strobe pulses from the oscillator **18** to the trigger input terminal T of a triggerable

flip-flop **24**. The retiming signal **26** as shown in line *d* of FIG. 2, is derived from the "1" output terminal of the triggerable flip-flop **24**.

The video signal source **12** may be located remotely from the cathode ray tube **14** and consequently the single ended bilevel video signals from the source **12** are converted into a double ended output signal in a differential line driver **28** for transmission over a distance by a pair of twisted leads **30**. Such transmission reduces noise pick-up. A differential line receiver **32** is coupled to the twisted pair **30** to reconvert the double ended video signals to a single ended output signal. The retiming signal **26** from the flip-flop **24** is also applied to a differential line driver **34** wherein the retiming signal **26** is converted into a double ended output signal and transmitted via a pair of twisted leads **36** to a differential line receiver **38**. The receiver **38** reconverts the retiming signal **26** into a single ended signal.

The retiming signal **26** is first delayed in a variable delay line **40** and then shaped by a pulse shaping circuit **42** to provide a train of timing pulses such as shown by the waveform **44** in line *f* of FIG. 2. The retiming signal **26** is also inverted in an inverter **46** and then applied to a second delay line **48**. The delayed output thereof is shaped in a second pulse shaping circuit **50** to provide a group of timing pulses **52** as shown in line *f* of FIG. 2. The first **52** and second **44** groups of timing pulses are gated through an OR gate **54** to provide a composite signal **56** shown in line *g* of FIG. 2. The composite signal **56** is applied as one input to a pair of AND gates **58** and **60**. The other input to the AND gate **58** comprises the pulse width distorted video signal **16** derived from the differential line receiver **32** whereas the other input to the AND gate **60** comprises an inverted pulse width distorted signal as derived from an inverter **62**. The AND gates **58** and **60** are coupled respectively to the set (S) and reset (R) terminals of a video flip-uop **64**. The "1" output terminal of the flip-flop **64** is coupled to a video driver **66** that is coupled to blank and unblank the electron beam (not shown) in the cathode ray tube **14** to cause graphic characters such as shown by the character **15** to be formed on the face thereof.

## OPERATION

In describing the operation of the video reconstruction circuit **10**, it is assumed that a maximum frequency signal is first derived from the video signal source **12** so that the circuit **10** can be adjusted to reconstruct such a signal and thus eliminate the necessity of readjusting the circuit **12** for lower frequency signals. Such a maximum frequency video signal exhibits the pulse width distortion shown by the distorted signal **16** in FIG. 2. The distorted signal **16** is reconstructed into an ideal signal **22** by the reconstruction circuit **10**.

The clock strobe signal **20** is applied to the triggerable flip-flop **24** to generate a retiming signal **26** of half the pulse repetition rate of the strobe signal **20**. The retiming signal **26** is a replica of the maximum frequency signal **22**. The retiming signal **26** after processing by the receiver **38** is delayed in the delay line **40** and shaped in the pulse shaper **42** to provide the group of timing pulses **44**. The pulse shaper **42**, may for example, comprise a one-shot multivibrator that is triggered on the deloyed leading edge of a pulse in the retiming signal **26** to produce a relatively narrow pulse output therefrom. Thus, the group of timing pulses **44** are generated by the positive going transitions in the retiming signal **26**. The retiming signal **26** is also inverted in the inverter **46** and delayed and shaped in the delay line **48** and pulse shaper **50** to provide the group of timing pulses **52**. The pulse shaper **50** may be identical to the shaper **42** but since the retiming signal is inverted, the pulse shaper **50** produces a timing pulse **52** on each negative going transition in the retiming signal **26**. The delay line **48**



is adjusted so that the group of timing pulses **52** occur at the approximate center of the narrowest portion of the distorted video signal waveform **16**. The narrowest portions of the distorted signal **16** are shown by the reference number **70** in line *c* of FIG. 2. The delay line **40** is then adjusted to center the second group of timing pulses **44** between the first group of timing pulses **52**. The effect of shifting the first and second groups of timing pulses in relation to each other is to provide the correct timing signals that locate the transitions in amplitude that should occur in an ideally reconstructed maximum frequency video signal. Accordingly, the composite signal **56** of the first and second groups of timing pulses are utilized to gate the distorted waveform **16** through the AND gates **58** and **60**, respectively.

As shown in line *h* of FIG. 2, the first timing pulse in the composite waveform **56** activates the AND gate **58** since the first elongated pulse in the distorted signal **16** has already enabled the gate **58**. Consequently, the flip-flop **64** is set to produce the first output pulse in the reconstructed waveform **68**. The flip-flop **64** remains set until the second timing pulse in the composite signal **56** arrives to activate the AND gate **60** and reset the flip-flop **64**. The AND gate **60** had been enabled previously because the inverted narrow pulse **70** in the distorted signal **16** arrived at the gate **60** beforehand. Succeeding timing pulses set and reset the flip-flop **64** at the maximum frequency signal rate and therefore produce the reconstituted video signal **68**. The video signal **68** is a replica, albeit a delayed replica, of the ideal maximum frequency signal **22**. The delay exhibited, of course, only shifts the positioning of the character **15**, but does not distort it.

A maximum frequency signal can exhibit up to slightly less than $\pm 50\%$ pulse width distortion and can still be reconstituted accurately by the circuit **10**.

It is noteworthy that the circuit **10** not only compensates for pulse width distortion that occurs prior to the video reconstruction, but it can also be adjusted to compensate for pulse width distortion that occurs after this process takes place. In other words, the final adjustment of the variable delay lines **40** and **48** would normally be such that the video signal at the video driver **66** output would be a replica of the original video, thus eliminating the pulse width distortion that occurs in the video driver modules.

Thus, in accordance with the invention, a bilevel video reconstruction circuit is provided that removes pulse width distortion from bilevel video signals.

What is claimed is:

**1.** A video reconstruction circuit for removing pulse width distortion from distorted bilevel video signals in a graphic imaging system that processes video signals at frequencies up to a maximum frequency, comprising in combination,

means for generating a bilevel retiming signal at said maximum frequency rate,

first means for generating a first group of timing signals based on predetermined transistions in said bilevel retiming signal,

second means for generating a second group of timing signals based on the remaining transitions in said bilevel retiming signal,

means for centering timing signals from one of said groups between timing signals in the other group, and

means for gating distorted bilevel video signals and an inverted version of said distorted bilevel video signals with said first and second groups of pulses to provide a reconstructed bilevel video signal.

**2.** The combination in accordance with claim **1** wherein said retiming signal comprises a squarewave signal.

**3.** The combination in accordance with claim **2** wherein said retiming signal is generated in a triggerable flip-

flop coupled to be triggered by the strobe signal of said graphic imaging system.

4. The combination in accordance with claim 3 wherein said gating means comprises

a first AND gate to which said timing signals and said distorted bilevel video signals are applied, and

a second AND gate to which said timing signals and an inverted version of said distorted bilevel video signals are applied.

5. The combination in accordance with claim 4 that further includes a flip-flop having a first terminal coupled to the output of said first AND gate, and a second terminal coupled to the output of said second AND gate.



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